PCT/AU2004/001513

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WITNESS my hand this
Twelfth day of November 2004

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Patents Act 1990

PROVISIONAL SPECIFICATION

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INVENTION TITLE: ~~A moto~~ Self-orienting mote.

Self-orienting mote

TECHNICAL FIELD

This invention relates to the wireless devices (also known as motes or smart dust).

More particularly this invention relates to the micropower source for these devices.

BACKGROUND TO THE INVENTION

A mote typically comprises the following subsystems:

- Sensing subsystem
- Data processing
- Data transmission/reception
- Micropower

The sensing subsystem is for monitoring the mote environment (light, motion, UV-radiation, dangerous chemicals, radioactivity, sounds, temperature, biological warfare, etc.). This element converts a physical value subject of monitoring into a modulated electrical signal.

The data processing subsystem processes information coded in the modulated electrical signal and converts it commonly to digital format. This information is further transmitted by the transmission system to the nearest other mote or directly to the base. From time to time the base sends commands to the mote. The command may, for example, request the mote to terminate any transmission, or to transmit current status immediately.

All the subsystems described above require a power source for their operation. There are examples of micropower

sources based on electrochemical energy storage (batteries) and on a photovoltaic element for continuous charging of the battery. Energy requirements are the main limitation in designs of small motes.

In addition, the motes and their photovoltaic elements are realized in substantially flat structures. This affects aerodynamic properties of these devices and their visibility.

When the motes are realized in substantially spherical shapes it is difficult to ensure their proper orientation. The proper orientation is important, for example, for optimized utilization of antenna. However, there could be other reasons why specific orientation of a mote with respect to horizontal surfaces is essential for optimized operations (e.g. sensor element must be on the top- to sense air or at the bottom - to sense soil)

OBJECTIVES OF THE INVENTION

It is therefore an object of the present invention to provide a self-orienting mote.

SUMMARY OF THE INVENTION

The invention provides for the subsystems of a mote to be to be formed within a curved sealed envelope.

The envelope is commonly of a spherical type, however, it may be advantageous to implement other shapes, selected based on their aerodynamic properties and/or visibility.

According to one aspect of the invention, a thin film photovoltaic device is utilizing a surface of the envelope shape as a substrate.

In one embodiment, at least part of the envelope is optically transparent and the said photovoltaic device is formed on internal surface of the envelope.

In another embodiment, the said photovoltaic device is formed on external surface of the envelope.

In further embodiment according to this aspect of the invention, some layers of the said thin film photovoltaic device are formed on internal surface of the said envelope, whereas other layers are formed on external surface of the envelope.

Although, this specification describes shape of the envelope as spherical, the invention is not limited to geometrical spheres, but provides for other, substantially curved and not necessary regular shapes and/or sections or partitions of the sphere.

The invention provides for envelopes to be made of glass, plastic, metals or any other suitable materials.

Although, the invention describes a photovoltaic element of thin film type, it is beneficial to utilize some specific thin film technologies such as organic PV (OPV), dye solar cells (DSC), Si, CdTe or ICS solar cells.

From one aspect of invention the said envelope comprises spherical electrically conductive core, on which layers of the PV cell are sequentially deposited. The top,

electrically conductive layer comprise any of known transparent electrically conductive materials including, but not limited to
Transparent conducting oxides,
Conducting polymers,
Mesh made of conducting fiber.

The invention provides for a hole to be made in the envelope to enable external electrical connection(s) to the device. In one example these connections are made to antenna required for transmission/reception of information.

In one embodiment the conducting coating is extended to coat all or part of the internal surfaces of said hole(s) and provide said external electrical connection(s) and whereby said hole(s) are filled with the same or a second electrically conductive material or non-conducting material (e.g. ceramic glaze), forming a bond with said conducting coating and sealing said hole(s);

In another embodiment the said antenna is formed on internal or external surface of the envelope by isolating regions of the said electrically conductive material into appropriate shapes.

In yet, another embodiment the antenna is a wire extended to outside of the envelope or attached to the external surface of the envelope.

This invention provides for electrical connections to be made to said electrically conductive coating (including TEC) and/or to said electrically conductive material (ECM)

via holes in one or both of the substrates, thereby eliminating the need for said electrically conductive coating and/or said electrically conductive material to penetrate the hermetic seal of RPEC cells and modules.

One layer of the said device comprises semiconductor. For wide band gap semiconducting materials invention provides for photosensitization by dye, to absorb electromagnetic energy of light. It is preferably to utilise nano-dispersed semiconductors, thereby significantly increasing photoactive area of a cell.

In one embodiment layers of a cell are formed on internal surface of transparent spherical shape. The shape being made of glass, polymer or any other material transparent to the part of electromagnetic radiation that is absorbed by either dye when photoactive material comprise a dye attached to a semiconductor or just by semiconductor in absence of dye. Depending on application the part of the electromagnetic radiation comprise UV light, visible light, IR light or any combination thereof.

The invention also provides for using an internal space of a spherical device as an additional reservoir for electrolyte and drying agents. Additional electrolyte will extend useful life of the device by replacing lost or damaged electrolyte layer adjacent to the semiconducting layer. The semiconducting layer may or may not be covered by dye.

According to another aspect of the invention the mote is formed inside a spherical glass envelope (glass globe) Internal surface of the globe is completely or partially

coated by the transparent electronic conductor. Some regions of the transparent electronic conductor form a substrate for a thin film photovoltaic device.

Additionally an energy storage device is formed inside the envelope. The energy storage device is either a high capacity capacitor or an electrochemical battery or a combination thereof.

The invention provides for a thin energy storage device. The thin energy storage device is commonly formed to be adjacent to the thin film photovoltaic device. In some cases, however, the said thin energy storage device is formed on the separate part of internal or external surfaces of the envelope.

The said energy storage device and said photovoltaic device are electrically connected. It is found to be beneficial to place a diode in electrical circuit between these devices. The invention provides for thin film diode formed between the photovoltaic device and energy storage device. In some cases the layers of the said thin film diode cover substantially whole are of the photovoltaic device.

The invention also provides for conventional miniature energy storage device to be secured inside the said envelope.

In addition, the data processing and data reception/transmission subsystem are secured inside the envelope and electrically connected to the said energy storage device.

Position of the sensing subsystem in respect to the envelope depends on requirements of selected application.

For light sensing, the photovoltaic cell itself provides an electrical signal modulated in accordance with light intensity.

For some applications (such as chemical and biological monitoring) the sensing subsystem is placed outside the envelope. The invention provides for thin film sensors formed on full or part of external surface of the envelope.

To protect from mechanical impact the envelope is additionally enclosed in the rubbery type cover (e.g. polyurethane). For attaching to the various surfaces a layer of adhesive is created.

The motes of this type can be precisely delivered to a target position by accelerating a mote in a predetermined direction in such a way that after flying certain distance the mote will be in contact with the target object and adhesive will provide for the mote to remain in this position for a required length of time. The said acceleration may be given to a mote from a ground point or from the flying object (e.g. aircraft, helicopter).

Alternative the mote can be just dropped from a flying object. In this case height and speed of the flying object are taken into account to determine when to drop the mote in order for it to lend on predetermined surface.

The predetermined surface may belong to the moving ground object (e.g. car) or to a flying object.

In one embodiment the acceleration of a mote is achieved in a device similar to the air rifle, where a pressure force of compressed air accelerates the mote to a certain speed in a certain direction. The direction and magnitude of speed are selected in such way that projectile of the flying mote intersects surface of a target object.

In accordance with further aspect of this invention centre of gravity of a mote is shifted in such a way that under action of gravity force the mote is oriented in a predefined direction. This orientation ensures the lowest position of centre of gravity.

In one embodiment in accordance with this aspect of the invention a mote includes external antenna. The self-oriented mote ensures specific direction of the antenna (typically - upwards).

In another embodiment in accordance with this aspect of the invention, a mote additionally includes supporting means to ensure that the spherical body is positioned at a distance from the supporting surface.

The supporting means can include a rod or/and a spring attached to a body of the mote. In one example, the supporting means include a foot. The foot may be coated with adhesive to ensure firm attachment to the supporting surface.

According to another aspect of the invention a mote is self orienting due to by aerodynamic forces that it experiences on flying pass. In one embodiement this is

achieved by attaching small wings or a tale to the body of a mote. In another embodiment a body is shaped in such a way, that wing-like geometry is created.

The invention provides for a rod to be made needle like (sharp), thus, when the rod hits the supporting surface, the needle penetrates into the surface, ensuring attaching the mote in a specific orientation.

The invention also provides for self-propelling means for delivery of a mote to a target surface. In one embodiment s self-propelling is driven by chemical energy stored either inside a mote or in the attached small container. Part of the chemical energy remained after the self-propelling could be used to power the mote operations for a certain time.

A supporting surface that mote is attached to described in this specification could be horizontal, vertical or oblique.

DESCRIPTION OF DRAWINGS

Having broadly portrayed the nature of the present invention, embodiments thereof will now be described by way of example and illustration only. In the following description, reference will be made to the accompanying drawings in which:

Figure 1 is a diagrammatic representation of a mote formed in accordance with first example of the invention.

Figure 2 is a diagrammatic representation of a mote formed in accordance with second example of the invention

Figure 3 is a diagrammatic representation of a mote formed in accordance with third example of the invention

Figure 4 is a diagrammatic representation of a mote formed in accordance with forth example of the invention

Detailed description of drawings.

Referring to Fig.1 a mote comprises a body 1 with shifted centre of gravity 2. The mote is self-oriented on a supporting surface 3.

Referring to Fig. 2 a rod 4 functions as antenna.

Referring to Fig. 3 a spring 5 supports a mote 1 on a foot 6 coated with adhesive material.

Referrring to Fig. 4 a needle 7 penetrates a supporting surface 3. A tale 7 ensures selforientation of the mote.

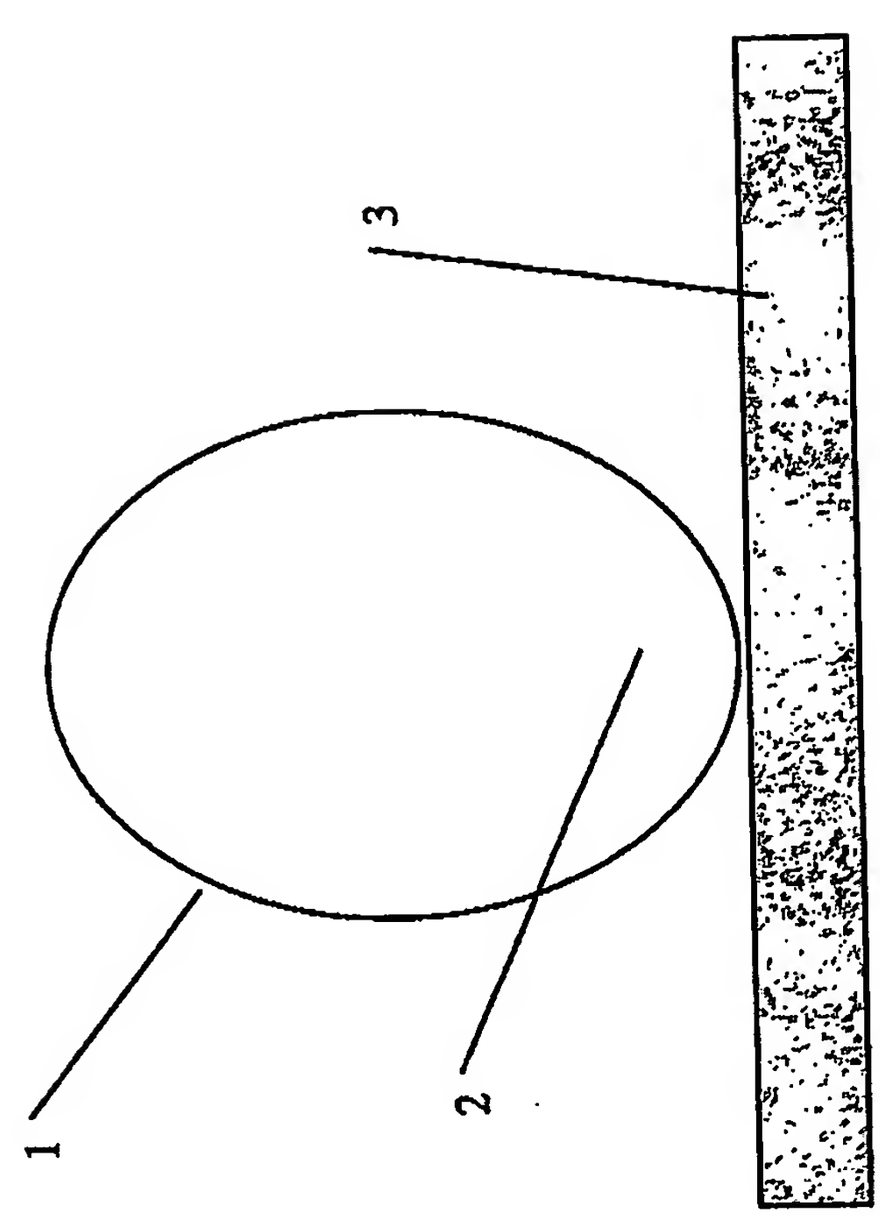

Fig. 1

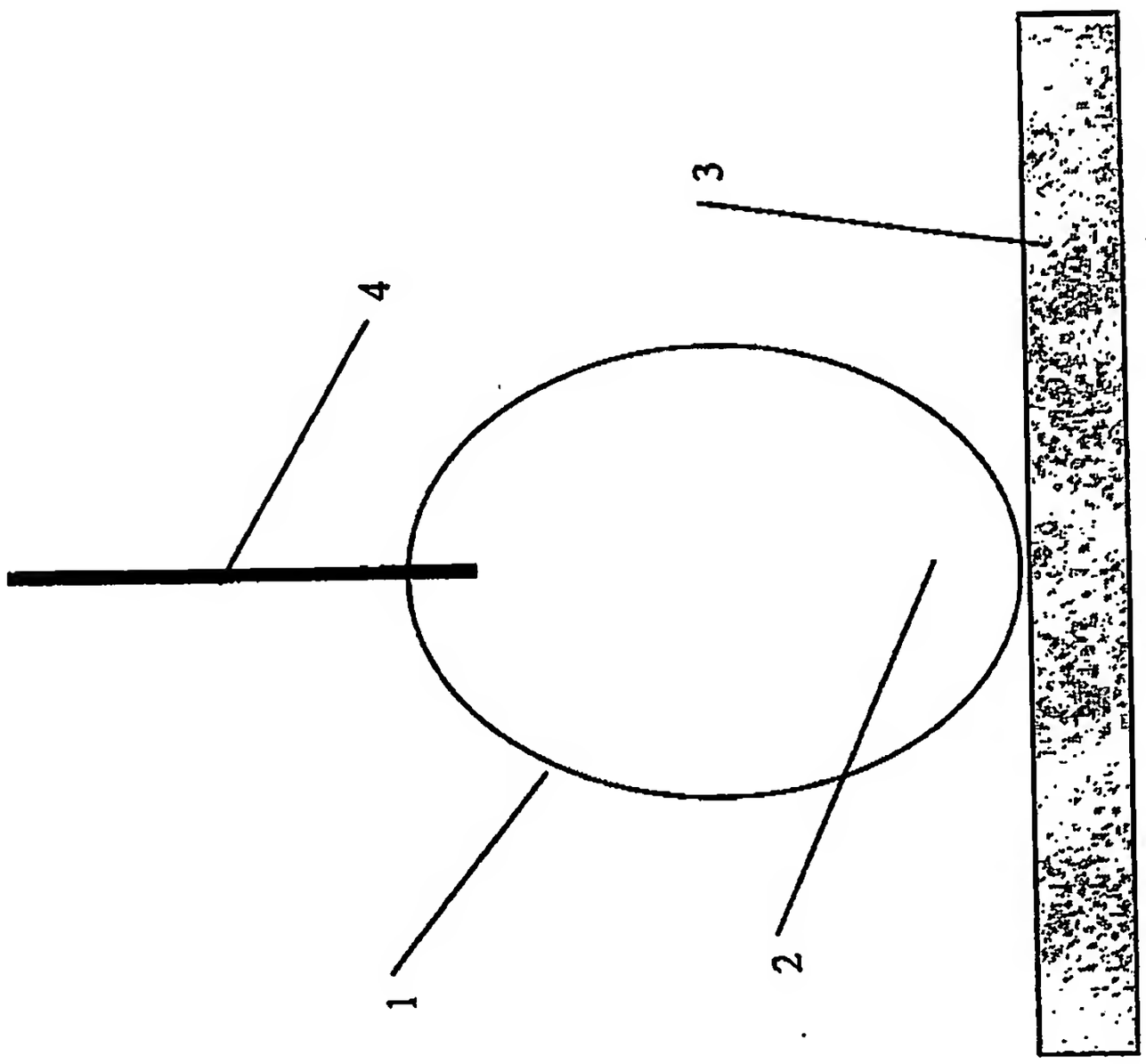

Figure 2

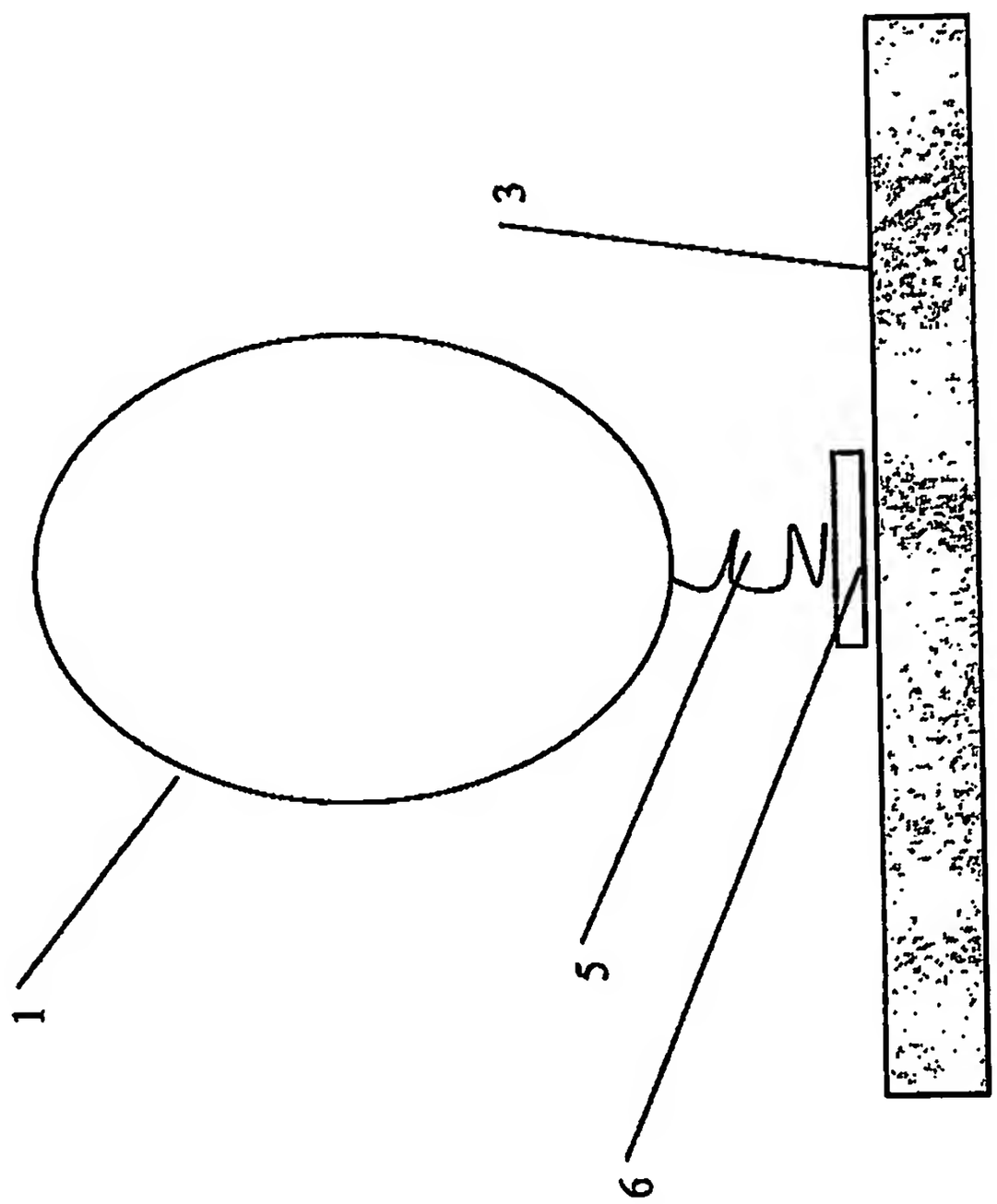

Figure 3

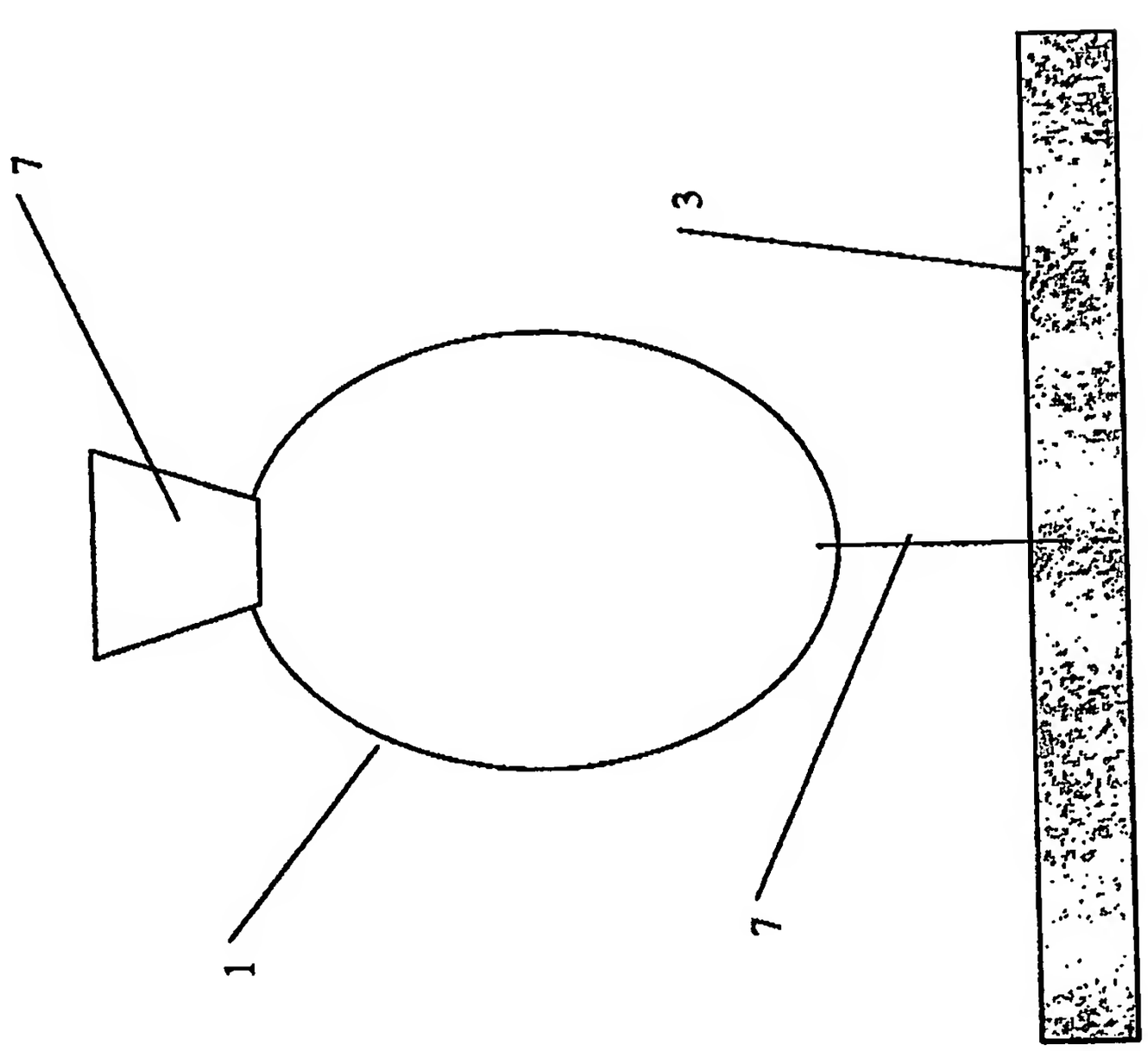

Figure 4

Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/AU04/001513

International filing date: 03 November 2004 (03.11.2004)

Document type: Certified copy of priority document

Document details: Country/Office: AU
Number: 2003906361
Filing date: 19 November 2003 (19.11.2003)

Date of receipt at the International Bureau: 08 December 2004 (08.12.2004)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)